COMPARATIVE STUDY OF THE POSTOPERATIVE PAIN AFTER OBTURATION USING CALCIUM SILICATE BASED AND EPOXY RESIN BASED ROOT CANAL SEALERS: A DOUBLE BLIND RANDOMIZED CLINICAL TRIAL

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Abstract:

Aim: The current study aims to compare the incidence and severity of postoperative pain following root canal filling with calcium silicate-based (Endoseal MTA sealer) and epoxy resin-based (AH Plus sealer) sealers.
Materials and Methods: 60 patients with asymptomatic irreversible pulpitis were randomly assigned into two groups based on the type of obturating sealer: the AH Plus sealer and the EndoSeal MTA sealer. These groups were then divided into two subgroups based on the number of visits, with subgroup A receiving a single-visit root canal treatment (RCT) and subgroup B receiving a two-visit RCT. After obturation, the postoperative pain was assessed using a visualanalogue scale.
Results: The present study was designed for the evaluation of incidence and intensity of pain after obturation using epoxy resin-based root canal sealer (AH Plus sealer) and calcium silicate-based sealers (Endoseal MTA sealer) in single visit and two visits treatment.
Conclusion: The two types of sealers examined did not have any significant impact on the incidence of postoperative pain. However, it was observed that the single-visit endodontic therapy resulted in higher levels of pain during the first three days compared to the two-visit therapy approach.

Keywords: AH Plus, Endoseal MTA, Postoperative pain, single visit, VAS

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1. INTRODUCTION

The achievement of successful RCT is obtained by thorough chemo-mechanical preparation, followed by a tightly sealed obturation, to avoid the entrance of microorganisms into the root canal space from the oral cavity or the periapex. The use of endodontic sealers in root canal fillings during obturation procedure is a well- established endodontic step, which is essential for the success of treatment. As a result, these materials are believed to possess a particular set of properties that allow for efficient obturation, healing of periapical inflammation, and the prevention of further microbial contamination. [(1)]

Traditionally, treated root canal systems are sealed with gutta-percha and endodontic sealers. These sealers are physiologically compatible to be applicated inside the root canal during endodontic therapy, even though they may come into direct contact with the periradicular tissues through lateral canals or apical foramina. [(2)]

The most commonly used obturating sealers are resin-based sealers, followed by the more recently developed bioceramic sealers. [(3)] Due to their excellent physico-chemical characteristics, resin-based sealers are frequently used in endodontics. The AH Plus sealer is recorded by many studies as the gold standard epoxy resin-based sealer. This sealer may penetrate deeper into the dentinal tubules and create a solid mechanical interlocking between dentin and sealer due to its flowability and long-term polymerization time. [(3)]

AH Plus presents higher solubility, pH and calcium ion release and less flow and radiopacity. Since one of the main purposes of RCT is the healing of the periapical tissues, it is necessary that the materials used inside the root canal favors this repair or at least does not promote any additional harm to these tissues. [(4)]

Calcium silicate-based sealers have shown promising results in terms of their physicochemical and antibacterial properties. They are known for their biocompatibility and bioactivity, which means they can chemically bond to the dentinal walls and form a structure similar to apatite. This characteristic enhances the sealing ability within the root dentin. [(5)]

Although obturating materials should be confined inside the root canal, the heated, or plasticized gutta-percha methods enable sealer penetration into periapical tissues, especially under favorable anatomical circumstances. There is a potential that the components of the sealer and the byproducts of its degradation will reach the periapical tissues even after taking adequate precautions during obturation. Due to their extensive contact with periapical tissues, root canal filling materials should possess strong physical, chemical, and biocompatibility properties. Tissue damage or a delay in the healing of inflamed periapical structures might result from toxic formulations of the sealer. [(6)]

Endodontic postoperative pain is defined as an uncomfortable sensation of any degree that appears after the startof root canal therapy. [(7)] The presence of postoperative pain is recorded in 3% to 58% of cases following endodontic procedures, depending on the patient pain threshold and the condition of the pulp before RCT. [(8)] Injuries to the peri- radicular tissues caused by mechanical, chemical, or microbiological processes may result in postoperative discomfort. [(9-12)] The careful selection of the obturation technique and materials will lower the risk of postoperative pain. [(13)]

It is difficult to quantify pain since it is influenced by so many variables, including personality, physical characteristics, and psychological aspects. The evaluation of pain following endodontic treatment has been done using a variety of scales and techniques. The majority of clinical studies use numerical, verbal, and visual analogue scales (VAS). [(6)]

The present study was designed for the evaluation of incidence and intensity of pain after obturation using epoxy resin-based root canal sealer (AH Plus sealer "Dentsply Sirona, Germany") and calcium silicate-based sealers (Endoseal MTA sealer "Maruchi, Wonju, Korea") in single visit and two visits treatment.

2. MATERIALS AND METHODS

STUDY DESIGN

The study was designed as a double-blind, randomized, controlled clinical trial with a 1:1 allocation ratio and a superiority framework. The study was conducted in the endodontic clinic at the Faculty of Dentistry, October 6 University. The ethical committee of the faculty of dentistry at October 6 University in Egypt, accepted the study's protocol (approval number RECO6U/11-2021). After receiving information about the goal of the trial and any possible dangers, volunteers filled out informed consent forms before starting therapy.

Sample size

An independent t test was performed to compare the effectiveness of the AH Plus sealer with the Endoseal MTA sealer in reducing postoperative pain. To detect a difference between groups using the independent t-test, it was estimated that 54 patients would be needed. [(14)] To compare more than two groups, one-way ANOVA was used, and to compare more than two intervals, repetitive one-way ANOVA was used, followed by Tukey's post hoc test for multiple comparisons. This number was increased to 60 patients (or 10% more than

calculated) to make up for follow-up losses.

Participants

The participants were chosen from the regular patients of the endodontic clinic at Faculty of Dentistry, October 6 University. The trial was announced in writing in the endodontic clinic, and patients who expressed interestin participating were assessed for eligibility and required to sign an informed consent form.

Through comprehensive clinical diagnosis using mirror and probe, percussion with the back of the mirror to show the existence of any swelling, and palpation with the index finger to indicate the presence of any soreness, patients were diagnosed and checked for eligibility requirements. To assess the vitality of the injured tooth pulp, an electric pulp tester (Denjoy DY310, Henan) was placed in the middle third of the labial surface of the tooth, with theneighboring and contralateral teeth serving as controls. Charts for medical history, dental history, and pain scale data were used to collect all the information. The i-scan image plate (Woodpecker, China) was used to acquire a preoperative intraoral periapical radiograph.

For measuring pain, the VAS is regarded as a legitimate and reliable scale. The variability of personal character may lead to some limitations in this method's objectivity. However, earlier research suggested that this approach can be regarded as sufficiently reliable. VAS was therefore employed in this study to assess post-operative pain. (15-17)

Based on the analysis of the radiographs, only patients with single-rooted maxillary anterior teeth that displayed straight canals were chosen. 70 mentally healthy, medically uninvolved patients of both sexes who needed root canal therapy were clinically diagnosed using periapical radiographs (70 patients were assessed for eligibility, 10patients were excluded “6 were not meeting inclusion criteria while 4 declined to participate”). On the basis of the following criteria, all of these patients were chosen for this study:

Inclusion criteria: Participants between the ages of 25 and 50 received proper oral care, patients didn’t medicated with analgesic or antibiotics in the previous seven days, prolonged response to the cold test, patients with deep carious lesions on their single-rooted teeth that have been identified as the source of their asymptomatic irreversible pulpitis, caries removal results in a profuse bleeding on exposure of the pulp, and patients whose periapical tissues were healthy (as shown by periapical radiography).

Exclusion criteria: People with underlying illnesses that make them more vulnerable to infection (such as those taking medication), severe periodontal disease (probing depth >4 mm), teeth with symptomatic irreversible pulpitis or with necrotic pulp, open apex, calcification, or resorption, other conditions as patients who required endodontic treatment for several teeth, individuals who were allergic to local anesthetics, lactating patients, pregnant females and those require a core buildup with significant coronal damage.

Patients were randomly distributed into into two main groups according to the type of the sealer:

- **Group I:** 30 patients obturated using AH Plus sealer.

And then the group was furtherly divided into two subgroups according to number of visits:Sub group A: 15 patients were done in single visit.
Sub group B: 15 patients were done in two visits.

- **Group II:** 30 patients obturated with Endoseal MTA sealer.

And then the group was furtherly divided into two subgroups according to number visits:Sub group A: 15 patients were done in single visit.
Sub group B: 15 patients were done in two visits.

Study Outcome: : Post-operative pain change.
Measuring device: Visual analogue scale.
Measuring unit: Ordinal.

Intervention

All teeth and soft tissues were cleansed with a gauze pad soaked in Povidone iodine solution prior to access opening. The teeth were anesthetized with 1.8 cc of 2% mepivacaine and 1:100,000 epinephrine (Carpule mepivacaine, Alexandria Company for Pharmaceuticals and Chemical Industries, Egypt, #1423). Isolation with rubber dam was applied on the selected tooth after the preparation of access cavity, using a round bur size 3 and an endo-Z bur (MANI,INC., Tochigi, Japan), for deroofing.

A #10 K-file (MANI, INC., Tochigi, Japan) was inserted up to the apical foramen, which was located using NSK IPEX II apex locator (NSK, Kyoto, Japan), then the file was withdrawn until the "0.5mm" mark on the electronic apex locator was reached. The file was then removed, and the length was measured using an endodontic ruler, then reinserted again inside the canal to the length determined by the apex locator for radiographic confirmation. EDTA gel (META BIOMED-Korea) was used as a lubricant. ProTaper Next rotary files (PTN, Dentsply Maillefer, Ballaigues, Switzerland), were used for canal preparation up to size X4 mounted on endodontic motor and gear reduction hand piece (NSK ENDO, Mate DT ENDO MOTOR).

The ProTaper Next system was used sequentially according to manufacturer instructions. The canals were carefully irrigated with 3 ml of 2% sodium hypochlorite (Cerkamed Poland CHLORAXID 2%) as an irrigant between each instrument. Then the final flush of the canal was done by the following irrigation protocol: 3 mL of 17% EDTA, 3 mL of 2% NaOCl, and 3 mL of distilled water respectively. [18] A final NaOCl irrigation process was applied by hand dynamic irrigation activation for 30 seconds with a properly sized gutta-percha cone. A periapical radiograph was captured to confirm the positioning of the master tapered gutta-percha cone (#40 taper 0.04) after it had been fitted to the root canal. [19]

In the single visit:

After confirmation of the master cone, the root canal sealer was manipulated in accordance to the manufacturer's instructions. A tiny amount of the sealer was injected into the canal after being dried with paper points. The master cone was inserted inside the canal after coating it with sealer till reaching the full WL then lateral compaction technique was done using appropriate size of finger spreader and auxiliary cones having the same size of the spreader. The pulp chamber was cleaned, excess gutta-percha was removed using a hot tool, and the remaining material was condensed vertically using a cold plugger. [19] The coronal access cavities were then sealed by temporary restoration. [20] Radiographic evaluation for obturation quality was performed for each tooth. Then we asked the patient to record any pain from this stage.

In the two visits:

All the involved canals in this group were irrigated with saline final irrigation after the chemo-mechanical preparation of the canals. Then a cotton pellet was placed inside the pulp chamber and covered with temporary restoration for one week.

After one week from the first visit, confirmation of the master cone was done. The root canal sealer was manipulated in accordance to the manufacturer's instructions. A tiny amount of the sealer was injected into the canal after being dried with paper points. The master cone was inserted inside the canal after coating it with sealer till reaching the full WL then lateral compaction technique was done using appropriate size of finger spreader and auxiliary cones having the same size of the spreader. The pulp chamber was cleaned, extra gutta-percha was removed using a hot tool, and the remaining material was vertically condensed using a cold plugger. [19] The coronal access cavities were then sealed by temporary restoration. [20] Radiographic evaluation for obturation quality was performed for each tooth. Then we asked the patient to record any pain from this stage.

Blinding

This study was conducted as double-blind randomized control trial where the participants and the Statisticianwere blind. Due to the study's criteria that the sealers can't be masked, due to their manipulation procedure difference, so the clinician couldn't be blinded.

Participants were not aware of the group they received care from; The patient choose an envelope randomly after M.S. packed numbered papers specifying the type of sealer in an opaque, closed envelopes. The type of sealer selected to the patient was based on the number present inside the envelope.

Harms

Any harm experienced by intervention participants was noted and reported at the conclusion of the experiment. The harm-adjusted course of treatment:

- To treat pain, anti-inflammatory analgesics should be used. (One tablet of Brufen 600 mg as needed).
- Swelling: heated fomentation, mouthwash made of warm, salty water, and antibiotic treatment(Augmentin 1 gm, pill once every 12 hours for five days) in the event of a fever or lymphadenopathy.

Statistical Analysis:

Statistical Package for Social Science (SPSS)® Version 24 and Minitab® statistical software Version 16 were used for data collection, tabulation, and statistical analysis. For further analysis, the data were presented as frequency and percentages for qualitative data and as mean and standard deviation for quantitative data. By examining the data distribution using the Kolmogorov-Smirnov and Shapiro-Wilk tests, numerical data will be examined for normalcy.

Independent t-tests were used to compare two different groups, one-way ANOVA tests to compare more than two different groups, and repetitive one-way ANOVA tests to compare more than two intervals, followed by Tukey's posthoc test for multiple comparisons.

3. RESULTS

70 patients were examined for eligibility, 10 patients were rejected (6 were not fulfil the inclusion criteria while 4 refused to participate); The remaining 60 patients were randomly divided, received intended treatment, and were analyzed for the pain assessment.

4 participants were exclused after the first treatment session (1 from each subgroup) as they

didn't return in the follow up session to deliver the chart of pain assessment.

Evaluation of the Postoperative pain:

Pain intensity:

1. Group I (AH Plus sealer):

Effect of time:

Minimum, maximum, median, range, mean and standard deviation values of the postoperative pain at different time intervals in both single visit and multiple visits of group I (AH Plus Sealer) were presented in table (1).

Comparison between different days was performed by using One Way ANOVA test which revealed significant difference in both single and multiple visits as P<0.0001* followed by Tukey`s Post Hoc test for multiplecomparisons which revealed that:

- In single visit: day 1 was significantly the highest, then decreased gradually at day 4.
- In two visits: day 1 was significantly the highest, then decreased gradually at day 3, while at day 4 therewas no pain.

Table 1: Minimum, maximum, mean and standard deviation values of the postoperative pain in single and multiplevisits of group I at different time intervals and comparison between different intervals to evaluate effect of time:

		Minimum	Maximum	Median	Range	Mean	Standard Deviation	P value
Single visit	Day 1	6.00	7.00	6.00	1.00	6.38 **a**	0.52	<0.0001*
	Day 2	5.00	7.00	6.00	2.00	5.75 **a**	0.71	
	Day 3	2.00	4.00	3.00	2.00	3.13 **b**	0.83	
	Day 4	0.00	2.00	0.00	2.00	0.75 **c**	1.04	
	Day 5	0.00	0.00	0.00	0.00	0.00 **d**	0.00	
	Day 6	0.00	0.00	0.00	0.00	0.00 **d**	0.00	
	Day 7	0.00	0.00	0.00	0.00	0.00 **d**	0.00	
Two visits	Day 1	4.00	6.00	5.00	2.00	4.75 **a**	0.71	<0.0001*
	Day 2	0.00	4.00	2.00	4.00	2.00 **b**	1.20	
	Day 3	0.00	2.00	0.00	2.00	0.50 **c**	0.76	
	Day 4	0.00	0.00	0.00	0.00	0.00 **c**	0.00	
	Day 5	0.00	0.00	0.00	0.00	0.00 **c**	0.00	
	Day 6	0.00	0.00	0.00	0.00	0.00 **c**	0.00	
	Day 7	0.00	0.00	0.00	0.00	0.00 **c**	0.00	

**Significant difference as P<0.05.*

Mean values with the same superscript letters were insignificantly different as P>0.05.Mean values with different superscript letters were significantly different as P<0.05.

Effect of number of visits:

Mean and standard deviation values of single and multiple visits pain in group I was presented in table (2).

Comparison between single and two visits was calculated using independent t test which revealed that: There was a significant difference between both subgroups as P<0.0001* at:

The first three days the subgroup I A was significantly higher than subgroup I B, while at day 4 there wasinsignificant difference between 2 subgroups as P=0.06 and there was no pain in both subgroups at day 5,6,7.

Table 2: Mean and standard deviation values of the postoperative pain in single and two visits of group I at differenttime intervals and comparison between visits to evaluate effect of visits:

	Single visit		Two visits		P value
	Mean	Standard Deviation	Mean	Standard Deviation	

Day 1	6.38	0.52	4.75	0.71	<0.0001*
Day 2	5.75	0.71	2.00	1.20	<0.0001*
Day 3	3.13	0.83	0.50	0.76	<0.0001*
Day 4	0.75	1.04	0.00	0.00	0.06 ns
Day 5	0.00	0.00	0.00	0.00	-----
Day 6	0.00	0.00	0.00	0.00	-----
Day 7	0.00	0.00	0.00	0.00	-----

M: meanSD: standard deviation
Ns: Non-significant difference as P>0.05 ** Significant difference as P<0.05*

2- Group II (Endoseal MTA sealer):
Effect of time:
Minimum, maximum, median, range, mean and standard deviation values of the postoperative pain at different time intervals in both single visit and multiple visits of group II (Endoseal MTA Sealer) were presented in table (3).
Comparison between different days was calculated using One Way ANOVA test which revealed significant difference in both single and two visits as P<0.0001* followed by Tukey`s Post Hoc test for multiple comparisons which revealed that:

- In single visit: day 1 was significantly the highest, then decreased gradually at day 4, while at day 5 therewas no pain.
- In two visits: day 1was significantly the highest, then decreased gradually at day 3, while at day 4 therewas no pain.

Table 3: Minimum, maximum, mean and standard deviation values of the postoperative pain in single and two visitsof group II at different time intervals and comparison between different intervals to evaluate effect of time:

		Minimum	Maximum	Median	Range	Mean	Standard Deviation	P value
Single visit	Day 1	6.00	7.00	6.00	1.00	6.38 a	0.52	<0.0001*
	Day 2	5.00	6.00	5.00	1.00	5.38 b	0.52	
	Day 3	2.00	4.00	3.50	2.00	3.38 c	0.74	
	Day 4	0.00	2.00	1.00	2.00	1.00 d	1.07	
	Day 5	0.00	0.00	0.00	0.00	0.00 e	0.00	
	Day 6	0.00	0.00	0.00	0.00	0.00 e	0.00	
	Day 7	0.00	0.00	0.00	0.00	0.00 e	0.00	
Two visits	Day 1	4.00	6.00	5.00	2.00	4.75 a	0.71	<0.0001*
	Day 2	0.00	4.00	2.00	4.00	2.00 b	1.20	
	Day 3	0.00	2.00	0.00	2.00	0.50 c	0.76	
	Day 4	0.00	0.00	0.00	0.00	0.00 c	0.00	
	Day 5	0.00	0.00	0.00	0.00	0.00 c	0.00	
	Day 6	0.00	0.00	0.00	0.00	0.00 c	0.00	
	Day 7	0.00	0.00	0.00	0.00	0.00 c	0.00	

Effect of number of visits:

Mean and standard deviation values of single and two visits pain in group II was presented in table (4). Comparison between single and two visits was calculated by using Independent t test which revealed that:

There was a significant difference between both subgroups as P<0.0001*at:

The first four days the subgroup II A was significantly higher than subgroup II B, while at 5,6,7 days there wasno pain in both subgroups.

Table 4: Mean and standard deviation values of the postoperative pain in single and two visits of group II at differenttime intervals and comparison between visits to evaluate effect of visits:

	Single visit		**Two visits**		**P value**
	M	SD	M	SD	
Day 1	6.38	0.52	4.75	0.71	<0.0001*
Day 2	5.38	0.52	2.00	1.20	<0.0001*
Day 3	3.38	0.74	0.50	0.76	<0.0001*
Day 4	1.00	1.07	0.00	0.00	0.01*
Day 5	0.00	0.00	0.00	0.00	-----
Day 6	0.00	0.00	0.00	0.00	-----
Day 7	0.00	0.00	0.00	0.00	-----

M: mean SD: standard deviation

Ns: Non-significant difference as P>0.05 ** Significant difference as P<0.05*

3. Comparison between both groups:

Mean and standard deviation values of the postoperative pain in both groups regarding single and two visits at different time intervals were presented in table (5) and figure (1)

Comparison between them was calculated using Independent t test which revealed insignificant differencebetween them at all days as P>0.05.

Table 5: Mean and standard deviation values of postoperative pain in both groups at different time intervals andcomparison between them:

No. of visits	**Follow up**	**Group I**		**Group II**		P value
		M	SD	M	SD	
Single visit	Day 1	6.38	0.52	6.38	0.52	1.00
	Day 2	5.75	0.71	5.38	0.52	0.52
	Day 3	3.13	0.83	3.38	0.74	0.53
	Day 4	0.75	1.04	1	1.07	0.64
	Day 5	0	0	0	0	-----
	Day 6	0	0	0	0	-----
	Day 7	0	0	0	0	-----
	Day 1	4.75	0.71	4.75	0.71	1.00

Two visits	Day 2	2	1.2	2	1.2	1.00
	Day 3	0.5	0.76	0.5	0.76	1.00
	Day 4	0	0	0	0	-----
	Day 5	0	0	0	0	-----
	Day 6	0	0	0	0	-----
	Day 7	0	0	0	0	-----

M: meanSD: standard deviation
Ns: Non-significant difference as P>0.05 ** Significant difference as P<0.05*

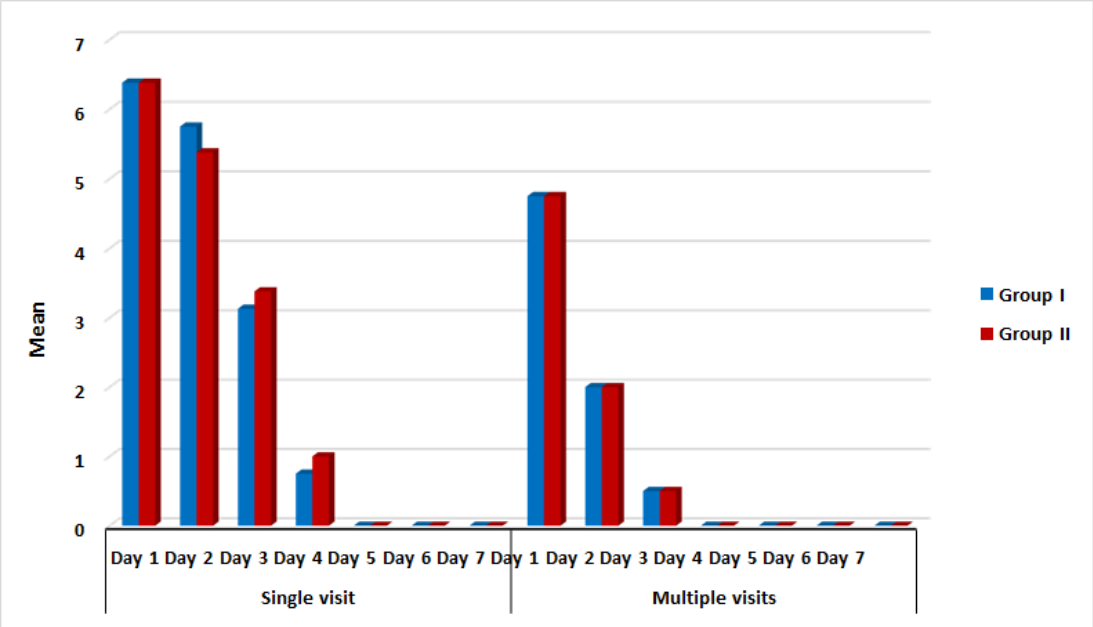

Figure 1: Histogram showing mean of postoperative pain in both groups at different time intervals

3. DISCUSSION

The goal of root canal obturation is to create a hermetic seal that shields the apical tissue from different oral bacteria. Filling the root canal with gutta percha was the prior attempt to create a tight barrier, given that the gutta percha has better characteristics and biocompatibility than the sealer. (21)

Compared to traditional methods of introducing root canal sealer inside the canal, there is a greater liability for calcium silicate-based sealers to extrude beyond the apical foramen, when practitioners administer them directly using a syringe and needle. The escape of sealer through the apical constriction will cause irritation to the periapical tissues, resulting in a postoperative discomfort. (21)

AH Plus has an 8-hour setting time, according to the manufacturer. However, little study has been done on how much epoxy polymerizes over time, which could have an impact on how well the epoxy bonds to the gutta percha.
(22)

However, important disadvantages of the current epoxy resin-based sealers include leakage, cytotoxic effect, and their prolonged setting times. Due to these drawbacks, new sealers must be created that employ nontoxic, fast setting time, and antimicrobial properties to reduce secondary inflammation and infection rates. (23)

Contact of periapical tissues with unset paste of resin-based sealers can cause an acute inflammation, resulting in irritation and discomfort. Local and systemic allergies have occasionally also been noted. (24)

The dimensional stability of resin-based sealers is impaired by polymerization shrinkage. The polymerization shrinkage of AH Plus = 1.76% of the total volume, due to its low linear expansion

and moderate shrinkage, AH Plus has long-term dimension stability. [24]

Alumina, calcium silicates, bioactive glass, zirconia particles, hydroxyapatite, and resorbable calcium phosphates are typically found in bioceramic sealers. These components give the sealers their ability to be biocompatible, have an antibacterial impact, and even promote dynamic intratubular biomineralization. Additionally, bioceramics improve endodontic treatment outcomes by assisting odontoblast development and the release ofbioactive compounds. [25]

The Endoseal MTA sealer has the advantage of rapid-setting, which offers several clinical benefits and improves appointment efficiency compared to previous MTA and bioceramic sealers that took hours or days to set. In the past, the use of MTA/bioceramic sealers was limited in certain clinical applications, as capping material, perforation repair, and retrograde filling, due to the risk of material washout. These procedures required a more substantial and challenging-to-use MTA/bioceramic material, often requiring additional appointments to ensure complete setting of the material [26].

Understanding the factors associated with postoperative pain enables professionals to make a better selectionfor the techniques and materials that can reduce the risk of pain occurrence. Root canal sealers have the potential to trigger inflammation and sensory neurons activation, which may contribute to postoperative pain following root canaltreatment [26].

Pain is a highly subjective sensation that is challenging to measure and standardize. It is affected by various factors, including individual personality, behavior, physical attributes, and psychological aspects, making it difficult to quantify accurately. [27]

Several techniques used in root canal therapy have the potential to worsen existing periapical inflammation and generate biochemical mediators such as reactive oxygen species. These mediators are known to induce inflammatory pain in vivo. [28]

Different scales and methods have been employed to evaluate pain following endodontic therapy. Numerical, verbal, and visual analogue scales are commonly used in clinical studies to assess postoperative pain. In the present study, postoperative pain was evaluated using a visual analogue scale, which is a reliable and widely used method inendodontic literature. [29]

The visual analogue scale (VAS) is widely recognized as a valid and reliable method for assessing pain. However, it should be acknowledged that due to the subjective nature of pain perception, there may be limitations interms of objectivity when using this method. Nevertheless, previous research has supported the relevance and reliability of the VAS. Therefore, in this study, the VAS was employed to evaluate postoperative pain [30].

Postoperative pain was documented by providing each patient with a pain scale chart, specifically (VAS), to record their pain levels following the intervention. The pain scale utilized a 100 mm horizontal ruler, with only a 0 atthe beginning and a 10 at the end, without any additional numbers. Participants were instructed to mark the point on the scale that corresponded to their perception of pain intensity. Pain levels were categorized as follows: no pain (0),mild pain (1-3), moderate pain (4-7), and severe pain (8-10). Postoperative pain was assessed daily for one week following the obturation [30].

The findings of our study of post-operative pain after a single visit obturation with AH plus sealer revealed that pain on the first day was significantly higher than pain after multiple visits. The same results were observed for the evaluation of the postoperative pain after obturation that was done by using EndoSeal MTA sealer.

When comparing both sealers in terms of postoperative pain after obturation, regardless of whether it was asingle or multiple visits procedure, no significant difference was observed between them.

The findings of this study are consistent with a previous study conducted by **Ferreira et.al**. [31], which concluded that the use of AH Plus, MTA Fillapex, and Endofill as root canal filling materials resulted in similar occurrences and intensities of postoperative pain, as well as the need for analgesic medication.

In addition, a study conducted by **Shim et.al**. [32] found that Endoseal MTA and AH Plus had similar effects on the occurrence and intensity of postoperative pain. Moreover, the Endoseal MTA group required less time for the obturation procedure compared to the AH Plus group. Therefore, using Endoseal MTA in combination with the single-cone technique was identified as a fast and painless option for obturation.

Lim et al. [33] conducted a study and reported that there was no correlation between the occurrence of sealer extrusion and the frequency or severity of postoperative pain. This finding held true, without recording the type of sealer used. The individual results from the eligible trials did not support the hypothesis that sealer extrusion could lead to

postoperative problems. The researchers suggested that this outcome could be attributed to the fact that the trials reported only a small amount of extruded cement, which was not enough to elicit a significant inflammation in the periradicular tissues.

Wong et al. [34] reported that both single-visit endodontic therapy and multiple-visit endodontic therapy have their advantages and disadvantages. While some dentists may consider the single-visit approach as a substitute for multiple visits, they have no issue with performing either approach. However, careful case selection is crucial for the success of endodontic treatment, and no steps should be skipped throughout the therapy process. Dentists should evaluate their own clinical abilities as well as the patient's needs. Despite the use of a one-visit treatment strategy, it is important for doctors to adhere strictly to endodontic principles.

Fonseca et al. [35] recorded that both single-visit endodontic therapy and multiple-visit endodontic treatment can potentially lead to postoperative pain, and these results were similar to our current study results.
The objective of the present study was to compare the occurrence of pain between single-visit and multiple-visit endodontic approaches.

Alomaym et al. [36] and **Keskin et al**. [37] found a statistically insignificant lower intensity and duration of pain in multiple visits endodontic treatment than in single visit group, and these results were aligned with our current study results.

4. CONCLUSION

The two types of sealers examined did not have any significant impact on the incidence of postoperative pain. However, it was observed that the single-visit endodontic therapy resulted in higher levels of pain during the first three days compared to the two-visit therapy approach.

Conflicts of interest

There were no conflicts to declare.

Ethical approval

The study obtained ethical approval from the Ethics Committee of the Faculty of Dentistry, October 6 University, Egypt, with approval number (RECO6U/11-2021). Prior to the initiation of the therapy, all participants were provided with informed consent forms and were informed about the purpose of the study as well as any potential risks involved. This ensured that the participants had a clear understanding and voluntarily agreed to participate in the study.

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